MARQUETTE UNIVERSITY

Electrical and Computer Engineering Department Colloquium

Energy Data Analytics through the Lens of Graph Signal Processing

Tuesday, April 25, 2023
2:00 pm – 3:00 pm
Olin 202
Open to the Public
Reception in Olin 204
3:00 pm – 3:30 pm

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Assistant Professor

ABSTRACT: The availability of large volume of energy data in smart grids provides new opportunities to improve their critical functions. The energy data, by nature, bear structures due to the underlying interactions among the components of the system, which can be the result of physics of the electricity as well as operational, policy-based, and cyber functionalities governing these systems. A new perspective and technical paradigm in analyzing energy data can be built through the fast-growing field of Graph Signal Processing (GSP). GSP extends the classical signal processing techniques and tools to irregular graph domain, which makes it suitable for analyzing structured data and the dynamics of systems with interconnected components. By defining signals over the vertices of a graph, namely graph signals, the interactions and dynamics of measurements in smart grids can be modeled, captured and analyzed through the lens of rich GSP tools and techniques. In this talk, GSP-based approaches in addressing two problems in smart grids including cyber and physical stress detection and localization as well as power system state information recovery will be presented. For the first problem, the effects of various cyber and physical stresses in vertex, graph-frequency and joint vertex-frequency GSP domains will be discussed, which will form the foundation for the proposed GSP-based techniques for detection and locating of stresses. Recovering the state of unobservable power system components due to cyber attacks or limited meter availability is also an important problem, which will be formulated and discussed as a graph signal reconstruction problem. The tools and techniques from GSP can have wide range of applications and similar techniques can be applied to other structured data and systems.

BIO: Dr. Mia Naeini is an Assistant Professor in the Department of Electrical Engineering, University of South Florida (USF). Before joining USF, she was an Assistant Professor in the Computer Science Department at Texas Tech University (TTU). She received her Ph.D. degree in Electrical and Computer Engineering with a minor in Mathematics from University of New Mexico (UNM) in 2014. Her research interests include leveraging data analytics, network science, signal processing, graph signal processing and graph-empowered machine learning to integrate security and reliability measures as well as socio-behavioral models into the design and control of cyber physical- human (CPH) systems with a focus on smart grids. Her research has been supported by various funding agencies, including National Science Foundation (NSF), Defense Threat Reduction Agency, and Florida Center for Cybersecurity. She has received TTU New Faculty Award in 2017 for excellence in teaching and research, one of the Best Conference Papers at the IEEE PES General Meeting in 2022, and the NSF CAREER award in 2023. She has served as the associate editor of the IEEE Communication Letters and as the chair and technical program committee member of several workshops and conferences in the area of power and communication systems. She is a senior member of IEEE.